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Biological Review of the 1994 Texas Closure

by

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Introduction

In 1981, the Gulf of Mexico Shrimp Fishery Management Plan (FMP) was implemented with a primary objective being to increase the yield of brown shrimp harvested from Texas offshore waters. Since then, various aspects of the Texas closure management measure have been analyzed and reported on by scientists at the Southeast Fisheries Science Center (SEFSC). This report contains an overview of selected effects of the 1994 Texas closure and will be presented to the Gulf of Mexico Fishery Management Council (GMFMC) in January 1995.

Background

The Shrimp FMP regulates fishing for brown shrimp in the Exclusive Economic Zone (EEZ) off the coast of Texas. Provisions in the Shrimp FMP prohibited brown shrimp fishing from the coast line to 200-miles off Texas during the periods: May 22-July 15, 1981; May 26-July 14, 1982; May 27-July 15, 1983; May 16-July 6, 1984; and May 20-July 8, 1985. In 1986, 1987, and 1988 only the portion of the EEZ, from 9 to 15-miles, was closed to fishing. In 1986, the area was closed May 10-July 2, while in both 1987 and 1988, Texas offshore waters were closed from June 1-July 15. In 1989, the 200-mile closure again went into effect and has remained in effect every year since that time. Closure periods were June 1-July 15, 1989; May 15-July 8, 1990; May 17-July 6, 1991; May 15-July 6, 1992; May 15-July 6, 1993 and May 13-July 7, 1994. State of Texas regulations, implemented in 1960, prohibited shrimp fishing in the territorial sea off Texas during these same periods, except for the white shrimp fishery from the beach out to 4 fathoms. In 1990, however, state law prohibited

all shrimping activities including the 4 fathom daytime fishery. This closure was in effect during the 1991 through 1994 closures.

The management objectives of the Texas closure regulation (as specified in the Shrimp FMP) are to increase the yield of brown shrimp and eliminate the waste of the resource caused by discarding undersized shrimp caught during a period in their life cycle when they are growing rapidly. The objective of the 1960 through 1980 Texas territorial sea closures was to ensure that a substantial portion ($\geq 50\%$) of the shrimp in Gulf waters had reached 65 tails/pound or 112 mm in length by the season's opening. Thus, these temporary closures of the offshore fishery from mid-May to mid-July each year results in larger shrimp to the fishery and subsequently a higher market value.

Methods

Port agents collect statistics on the catch, effort, and fishing location of shrimp vessels operating in the Gulf of Mexico. These data provided information on the species, size and location of shrimp, as well as information on the catch rates and fishing efforts of the vessels in the fleet.

Conclusions

1. Recruitment

Maximum recruitment of postlarval brown shrimp into Texas and western Louisiana estuaries occurs during February through early April. A wide array of environmental and biological factors affect the fate of these young shrimp.

Salinity, temperature, and water height have been identified as important factors affecting the survival, growth and abundance levels of subsequent offshore populations. The amount of usable nursery area for juvenile and subadult brown shrimp appears to be related to the distribution of favorable salinities as well as to the tidal water height in marshes. Bay water temperatures exceeding 68° F in April and May are also favorable for above average shrimp production.

The spring of 1994 was very mild, with average estuarine water temperatures in April of about 70° F. These temperatures maintained average shrimp growth rates for postlarval shrimp entering Texas and Louisiana bays. Tidal water heights during late April and early May were average and provided young shrimp with moderate access to feeding areas in marsh nurseries. Rainfall amounts in Texas and Louisiana were below average during the spring of 1994 and allowed an average bay water salinity of about 20 ppt to be maintained in Texas. However, with excessive spring rainfall in the midwest areas of the United States, discharge from the flooding Mississippi River kept marsh salinities below average in Louisiana .

Based on the Galveston Bay, Texas, postlarval and juvenile brown shrimp 1994 indices of abundance, the bait index-model (Berry and Baxter, 1969) predicted that the brown shrimp season, from July 1994 through June 1995, would yield approximately 27.1 million pounds off the Texas Coast, approaching the 1960 through 1992 average of 27.3 millions pounds. This yield is conservative when compared to our environmental index model forecast of 37.0 million pounds (Matthews, personal communication, NMFS Galveston Laboratory). Louisiana biological indices showed that juvenile shrimp abundance in the inshore and nearshore areas were about average in May, suggesting

average recruitment and harvest this year. Based on these values and models predictions, we estimate a total catch in Louisiana of 31.7 million pounds during the May 1994 through April 1995 period. Thus, we should expect a combined annual brown shrimp production of 58.8 million pounds in the western Gulf of Mexico, which is only slightly above the 56.2 million pound average.

2. Fishing Trends

Louisiana

The May through August 1994 catch in Louisiana for inshore waters was 6.9 million pounds, with 96% of the total catch taken during May and June. Inshore production was substantially below the historical average for the May through August period (Table 1). May inshore production was 3.1 million pounds, with June production at 3.5 million pounds. Production declined considerably after June, with a catch of only 0.2 million pounds in July and 0.1 million pounds in August.

The Louisiana offshore fishery produced 5.0 million pounds of brown shrimp in May 1994. The majority of the catch occurred from depths of less than 10 fathoms in statistical subareas 13 and 14 (Figure 1). Catch per unit effort (CPUE) values were moderate in the eastern subareas (300 to 600 pounds per day) and low in the western subareas (200 to 300 pounds per day).

In June, the fishery off Louisiana produced 3.8 million pounds of brown shrimp with a fishing effort of over 10,000 days. Average CPUE value was 360 pounds per day. CPUE values were moderate (300 to 400 pounds per day) in

most statistical subareas (Figure 2). Compared to May, the majority of shrimp were caught further offshore in each of the five statistical subareas (13-17).

In July, the offshore fishery in statistical subareas 13-17 produced 2.8 million pounds of brown shrimp with an effort of about 5,900 days of fishing (Table 2). Average CPUE was 476 pounds per day. CPUE values were moderate in all subareas off Louisiana (Figure 3). Most of the shrimp were taken from water depths less than 10 fathoms in all statistical subareas.

In August, the Louisiana offshore fishery produced approximately 1.9 million pounds of brown shrimp with an effort level of 3,700 days. Average CPUE was only 513 pounds per day. CPUE was highest in statistical subareas 15 and 17, and moderate in all others (Figure 4).

Overall during the May through August 1994 period, 13.5 million pounds of brown shrimp were landed from the offshore Louisiana fishery. This catch level is about average when compared to the May through August period from 1981-1993 (Table 1). The catch resulted from a high expenditure of effort; a total of nearly 33,700 days of fishing occurred during this four month period off Louisiana. Average CPUE was 402 pounds per day. During May and June, sizes of landed shrimp were predominantly in the >67 count size class (Figure 5). However, as catch declined during July and August, the >67 count size class accounted for a smaller percentage of the overall catch. This trend was not observed in previous years.

Texas

In Texas bays, from May through August 1994, 6.8 million pounds of brown shrimp have been landed (Table 1). This represents an above average value when compared to other inshore catches for this period since the closure began in 1981. Monthly catches in 1994 were highest in May and June comprising 2.7 million pounds and 3.1 million pounds, respectively. These two months accounted for 85% of the Texas inshore catch during the four month period. Landings in July were 1.0 million pounds, and production decreased dramatically during August with approximately 118 thousand pounds landed.

Offshore production during May through August 1994 was 13.2 million pounds with 12.6 million pounds (95%) of the catch produced in the July through August period (Table 1). The total catch for this period was the fourth worst since EEZ closures were initiated in 1981 (Table 1). During the July through August period, the size composition of landed shrimp changed from 57% in the >41 count size groups in July to around 30% in the >41 count size groups during August (Figure 6). In previous 200-mile closure years (1981 - 1985 and 1989 - 1993) the volume of shrimp in the >41 count size groups in July averaged around 38%. Thus, smaller than average shrimp were landed during July 1994, when compared to the same month in previous years.

In May 1994, about 0.5 million pounds of brown shrimp were landed with fishing effort of around 1,600 days fished. CPUE was 321 pounds per day. CPUE values were low in subarea 18 (<200 pounds per day), moderate in subareas 20 and 21 (200 to 300 pounds per day), and high in subarea 19 (>600 pounds per day) (Figure 1).

With both state territorial and EEZ waters being closed to shrimp trawling, the June catch was as expected low (74,000 pounds). This is similar to values from most other June periods during 200-mile closure years. Effort could not be calculated for the area and average CPUE was not estimated. Catch was very low in all statistical subareas off Texas (18-21) (Figure 2).

After reopening of waters to fishing in July, 7.6 million pounds of shrimp were caught with 7,000 days fished. This is an average catch for the month of July, but effort levels were lower than normal (Tables 1 and 2). CPUE was 1,078 pounds per day fished (Table 2). This is the first year since 1991 that the July CPUE rate increased above 1000 pounds per day following a 200-mile closure. CPUE was low in subarea 18 (770 pounds per day), but very high (>1000 pounds per day) in subareas 19 - 21 (Figure 3). The greatest catch occurred in from 11-20 fathoms off statistical subareas 19 and 21 (Figure 3).

In August, the offshore Texas catch was 5.0 million pounds of brown shrimp with fishing effort of about 9,300 days. CPUE was around 543 pounds per day. Both catch and effort were moderate when compared to other August values. CPUE was low in comparison with most other August values, but higher than those observed in the previous two years (Table 2). Similar to previous years, the majority of the catch was concentrated in subarea 19 (Figure 4). All subareas off Texas experienced moderate CPUE values (400 to 700 pounds per day), with subarea 18 accounting for the highest CPUE at 697 pounds per day (Figure 4).

3. Distribution of Catch From Texas Waters

Some concern has been expressed that the distribution of landings following the Texas closure has changed in recent years. To evaluate this problem, the Texas offshore catch (all shrimp species) during the May through August period was partitioned by port of landing. Landing locations were summarized into five general groups. These groups included lower Texas ports (Port Mansfield, Aransas County, Riviera, Nueces County, Port Isabel and Brownsville), middle Texas ports (Brazoria County, Matagorda County, Calhoun County, Refugio County, Port Lavaca, Matagorda, Palacios, Port O'Connor and Seadrift), upper Texas ports (Jefferson County, Chambers County, Galveston Island, Harris County and Kemah), Louisiana ports (all Louisiana ports), and other ports (ports from Mississippi, Alabama, Florida and the U.S. east coast).

As discussed in the 1993 Texas closure report to the GMFMC (Nance, 1994), the distribution of shrimp catch from Texas offshore waters to various ports throughout the Gulf of Mexico has not significantly changed since 1977. Distribution of catch this year was not notably different than observed in past years (Figure 7). Ports on the lower Texas coast appear to have the greatest percentage of the landings at around 42%. This is followed by the middle Texas ports (27%), and the upper Texas ports (18%). This relationship holds true during both 15-mile (1986-1988) and 200-mile closure years (1981-1985, 1989-1994). During 1994, about 87% of the shrimp taken from Texas waters were landed in Texas ports.

4. Shrimp Landings by Port

The distribution of shrimp landings in Texas ports was examined to determine if changes in shrimp landings at the various ports had occurred since the initial closure in 1981. May through August Gulf-wide shrimp catch was summarized by port of landing. During the May through August period an average of about 35% of the shrimp caught in the U.S. Gulf of Mexico is landed in Texas ports. This distribution has not changed significantly during the 14 years of closures (high in 1991 of 43.7%, low in 1986 of 30.1%) (Figure 8).

The distribution of Texas landings by individual ports was also examined. Figure 9 shows landings of the five upper Texas coast ports, Figure 10 shows the landings of the five middle Texas coast ports, and Figure 11 shows the landings of the four lower Texas coast ports. The five upper Texas coast ports (with overall mean catch percentage) include Jefferson (9.3%), Chambers (0.9%), Galveston (3.1%), Harris (2.4%), and Kemah (7.7%). The five middle Texas coast ports (with overall mean catch percentage) include Port Lavaca (5.4%), Brazoria (9.4%), Matagorda (1.1%), Palacios (8.2%), and Seadrift (3.2%). The four lower Texas coast ports (with overall mean catch percentage) include Aransas (18.5%), Nueces (5.0%), Port Isabel (12.3%), and Brownsville (12.6%).

5. White Shrimp Catch off Texas

For the fifth consecutive year, the 0-4 fathom white shrimp fishery off Texas has been closed in conjunction with the Texas closure. During July 1990, following the first 0-4 fathom closure, the majority of the white shrimp caught were in the <15 count range (Figure 12). This trend towards larger shrimp

carried into August 1990, with the majority of the shrimp in the <30 count group (Figure 13). Following the 1991 closure, the majority of the shrimp in July were in the <20 count range, with a peak in production that had not been observed in any other year since 1960. One million pounds of white shrimp taken in July 1991 off the coast of Texas were about 2 times greater than in any previous recorded catch. Production of shrimp in August 1991 was still good, but landings during 1984, 1986 and 1990 were higher (Figure 13). White shrimp in August 1991 were still quite large, with the majority <25 count. Following the 1992 closure, most white shrimp in July were again in the <20 count range, with a peak in landings second only to the level experienced in 1991. Abundance in August 1992 was quite high, but unlike the previous two years, most of the catch was composed of small sized shrimp (>41 count). Following the 1993 closure, the majority of white shrimp in July were again in the <20 count range, but peak production was lower than observed during either 1991 or 1992 (Figure 12). Production in August 1993 was extremely low in comparison with all other years since 1980 (Figure 13).

After the 1994 closure, most of the white shrimp landed in July were in the <20 count range, with a peak in production equal to that experienced in 1992 (Figure 12). Production in August 1994 was above average when compared to all other years since 1980 (Figure 13).

References

- Berry, R. and K. Baxter. 1969. Predicting brown shrimp abundance in the northwestern Gulf of Mexico. *FAO Fish. Rep.* 57(3): 775-798.
- Nance, J. M. 1994. Biological review of the 1993 Texas closure. NOAA Technical Memorandum, NMFS-SEFSC-344, 23pp.

Table 1. May - August catch of brown shrimp in millions of pounds from Louisiana (13-17) and Texas (18-21)

Area	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
Louisiana														
Inshore	6.9	10.2	11.6	6.5	15.9	11.3	14.0	12.4	14.3	8.9	14.9	12.1	15.1	15.2
Offshore	13.5	13.5	11.4	20.6	24.9	20.5	14.9	20.8	22.8	16.4	13.6	8.8	13.7	23.1
Total	20.4	23.7	23.0	27.1	40.8	31.0	28.9	33.2	37.1	25.7	28.5	20.9	28.8	38.3
ANNUAL	*	27.8	28.0	32.4	45.6	37.7	34.2	40.6	45.7	32.1	32.7	24.9	33.3	43.2
Texas														
Inshore	6.8	6.1	4.3	7.8	7.4	6.1	6.9	7.6	5.1	5.4	7.1	5.9	4.1	4.2
Offshore	13.2	10.0	11.2	21.3	20.4	17.3	15.2	17.5	14.0	14.5	16.1	10.7	13.9	25.3
Total	20.0	16.1	15.5	29.1	27.8	23.4	22.1	25.1	19.1	19.9	23.5	16.4	18.0	29.5
ANNUAL	*	28.7	30.5	42.9	39.4	36.0	32.1	37.3	33.7	31.4	31.0	24.0	26.8	44.1
Offshore Only														
Louisiana														
May-June	8.8	7.1	5.0	15.5	18.8	13.0	6.6	11.5	13.2	10.9	7.1	3.9	8.6	12.6
July	2.8	4.2	3.8	3.2	4.5	4.9	4.1	6.0	6.3	3.0	3.8	2.6	3.3	7.5
August	1.9	2.2	2.6	1.9	1.6	2.6	4.2	3.3	3.3	2.5	2.7	2.3	1.8	3.0
ANNUAL	*	17.1	15.9	25.8	29.6	26.4	20.1	27.9	31.2	22.7	17.7	12.7	18.2	27.8
Texas														
May-June	0.6	0.8	0.5	1.2	0.8	1.0	2.7	3.3	3.3	0.6	0.8	0.7	0.8	0.4
July	7.6	5.2	6.4	12.7	11.9	7.3	7.5	8.9	5.7	8.3	8.8	5.2	6.6	10.4
August	5.0	4.1	4.3	7.4	7.7	9.0	5.0	5.3	5.0	5.6	6.5	4.8	6.5	14.5
ANNUAL	*	22.2	24.4	34.1	31.9	29.7	24.7	28.8	27.8	25.7	23.7	17.9	22.6	39.7

* calendar year data not complete.

Table 2. Summary of Offshore Fishing Effort and CPUE for Louisiana (13-17) and Texas (18-21)

	Fishing Effort (1000 Days)					
	Area 13 - 17			Area 18 - 21		
	May - June	July	August	May - June	July	August
1981	14.8	8.1	3.8	1.1	4.4	10.4
1982	14.2	6.4	3.4	2.6	5.2	10.2
1983	9.1	4.2	4.9	2.3	3.7	6.7
1984	9.8	6.4	4.7	2.4	8.2	9.0
1985	11.1	6.0	3.7	1.5	6.8	8.4
1986	15.9	7.5	4.3	6.3	6.3	6.2
1987	19.0	10.0	5.8	7.7	9.8	8.2
1988	18.8	7.5	8.0	7.1	9.6	8.7
1989	28.5	8.2	2.8	3.8	5.7	10.2
1990	25.3	9.3	3.0	2.8	8.3	8.2
1991	34.7	4.1	3.9	2.5	8.2	7.6
1992	22.2	7.0	5.2	1.7	8.7	8.6
1993	25.0	6.6	4.9	2.4	7.1	8.2
1994	24.1	5.9	3.7	1.9	7	9.3

	CPUE (Pounds per Fishing Day)					
	Area 13 - 17			Area 18 - 21		
	May - June	July	August	May - June	July	August
1981	852	927	799	308	2,382	1,408
1982	607	525	522	295	1,279	629
1983	430	415	470	310	1,414	714
1984	718	598	573	295	1,074	723
1985	982	612	682	389	1,223	672
1986	830	840	773	524	896	799
1987	605	595	577	429	905	653
1988	351	556	521	538	781	578
1989	454	603	832	273	1,276	889
1990	749	473	517	298	1,426	937
1991	448	752	496	483	1,554	971
1992	226	535	497	343	728	499
1993	286	635	444	317	729	497
1994	367	476	513	311	1,078	543

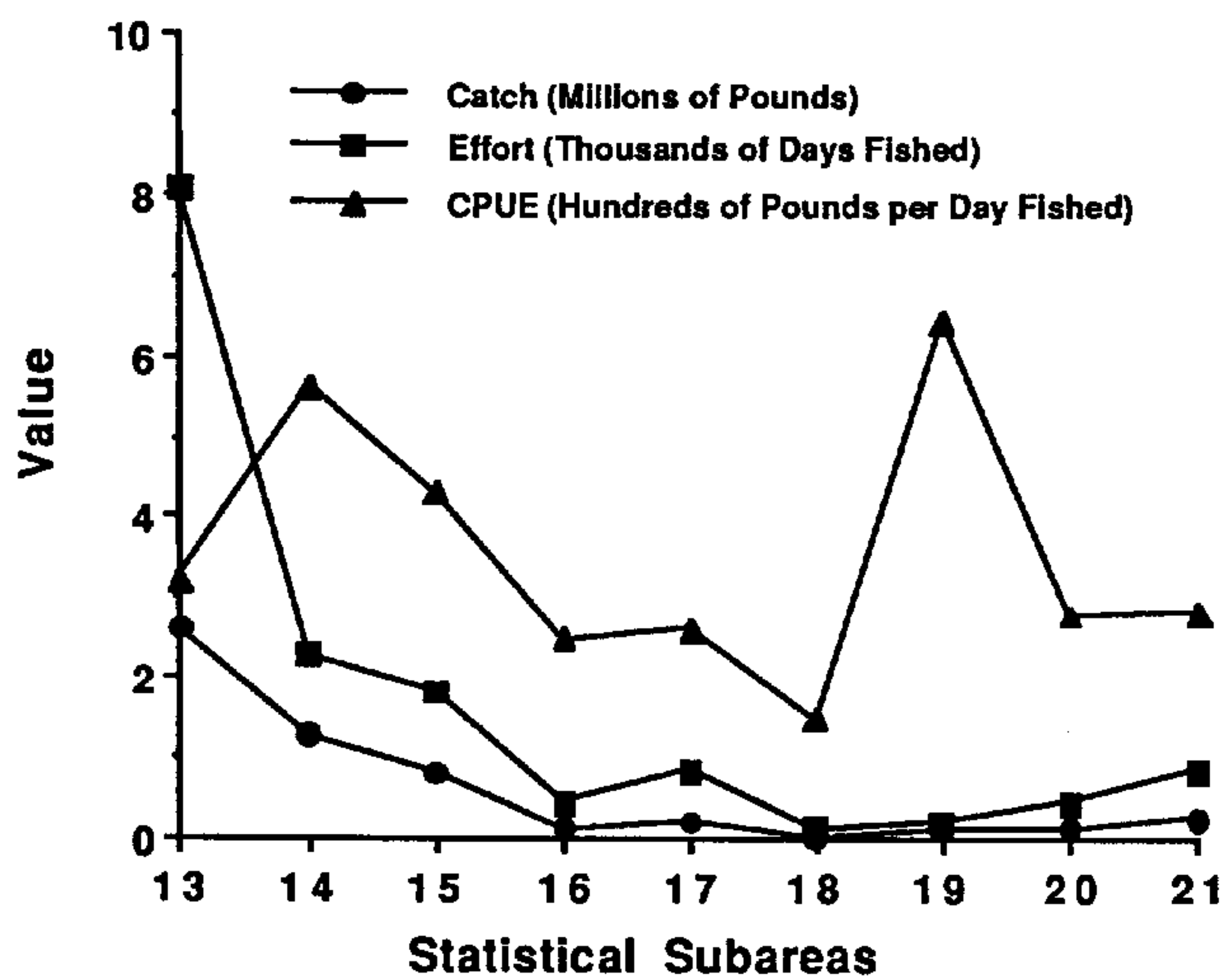
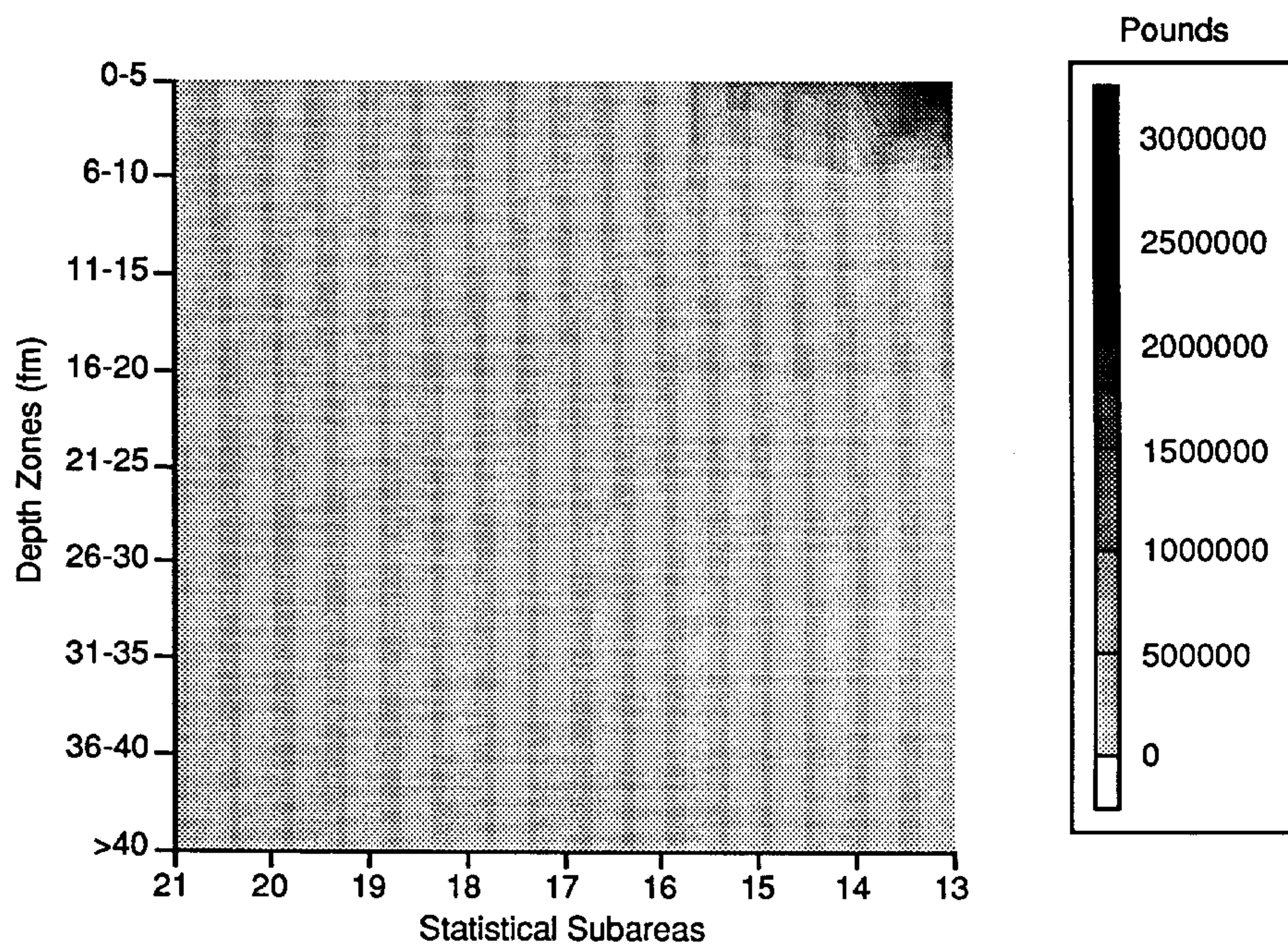


Figure 1. Offshore brown shrimp catch, effort and CPUE during May 1994.

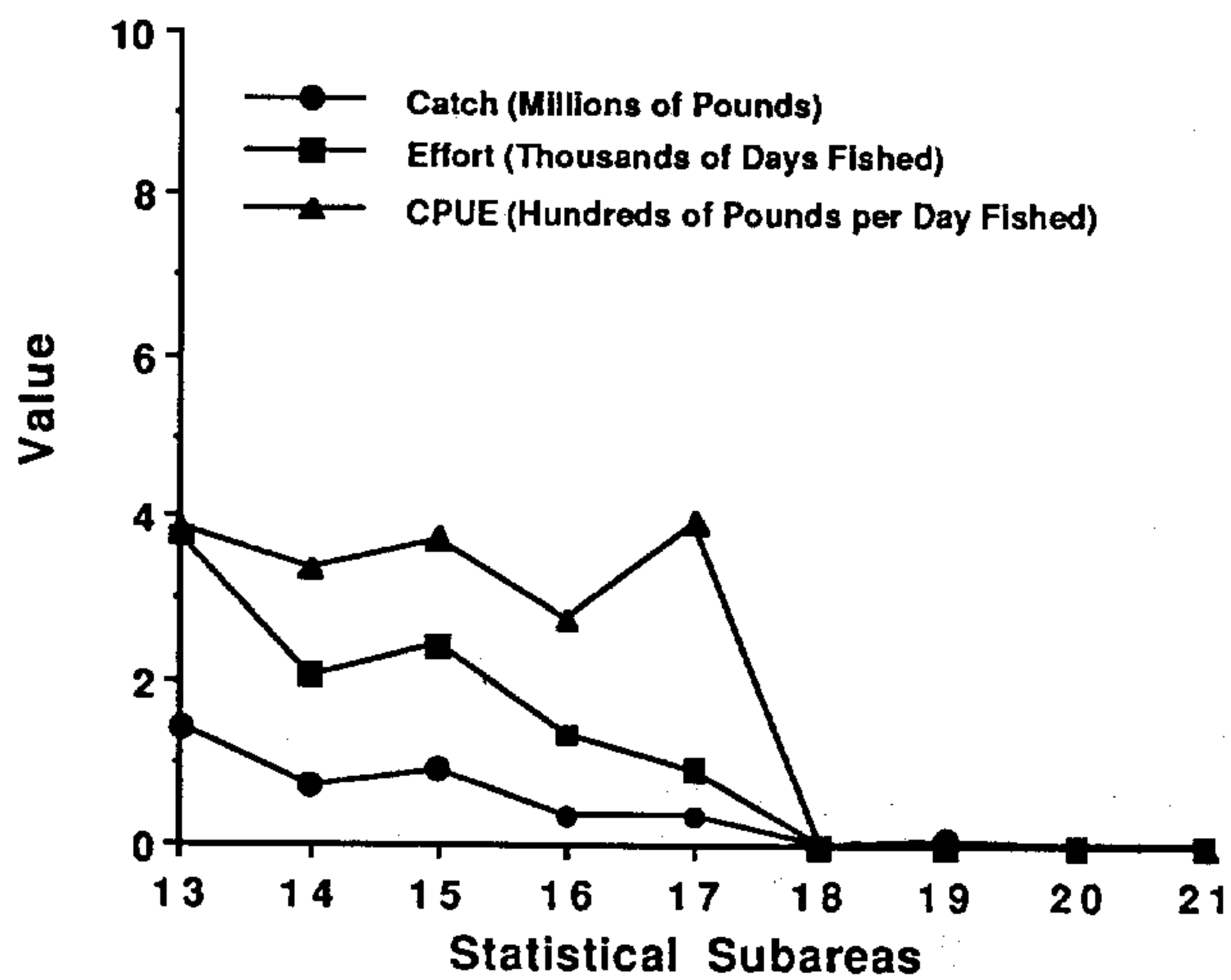
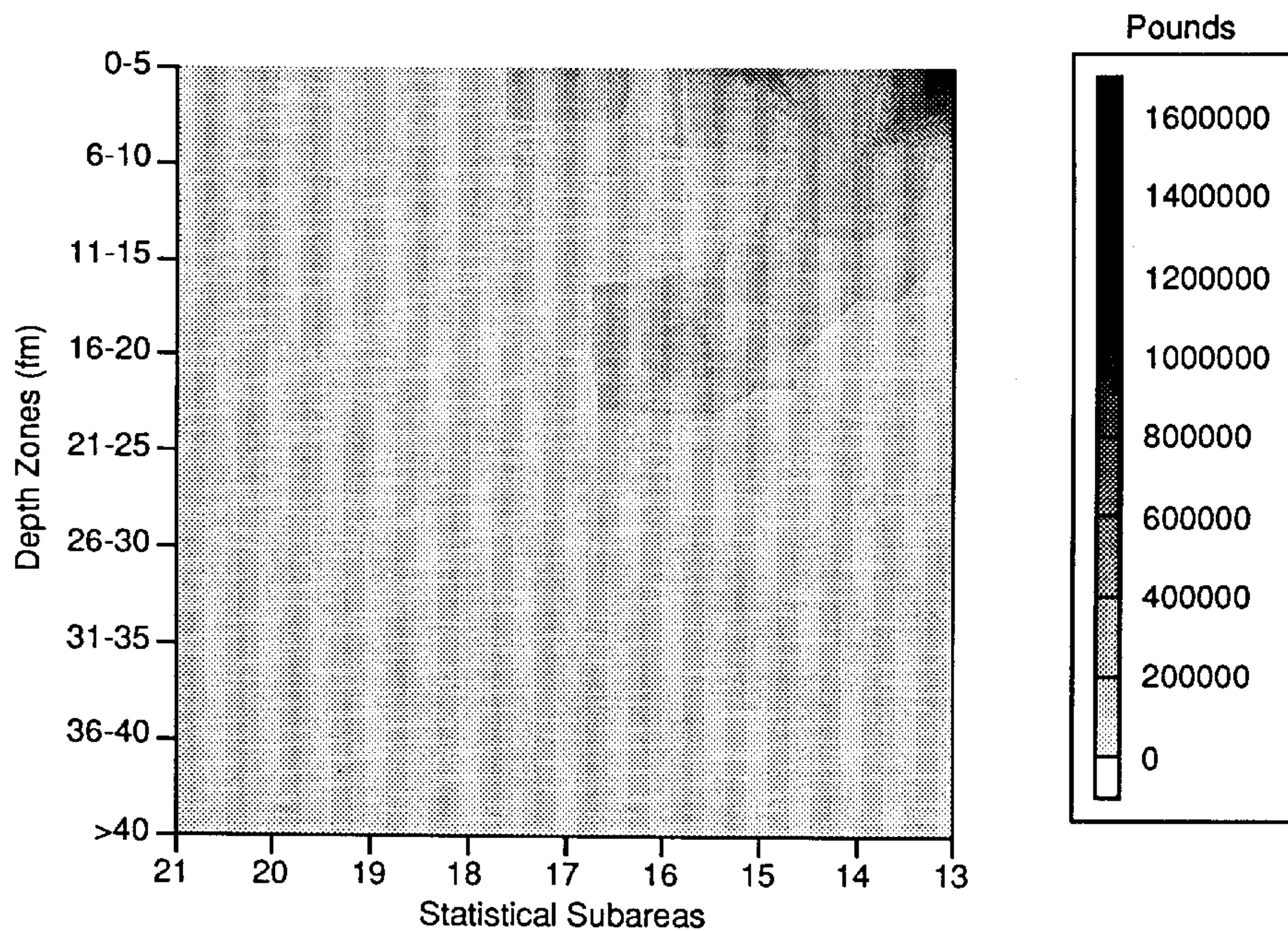


Figure 2. Offshore brown shrimp catch, effort and CPUE during June 1994.

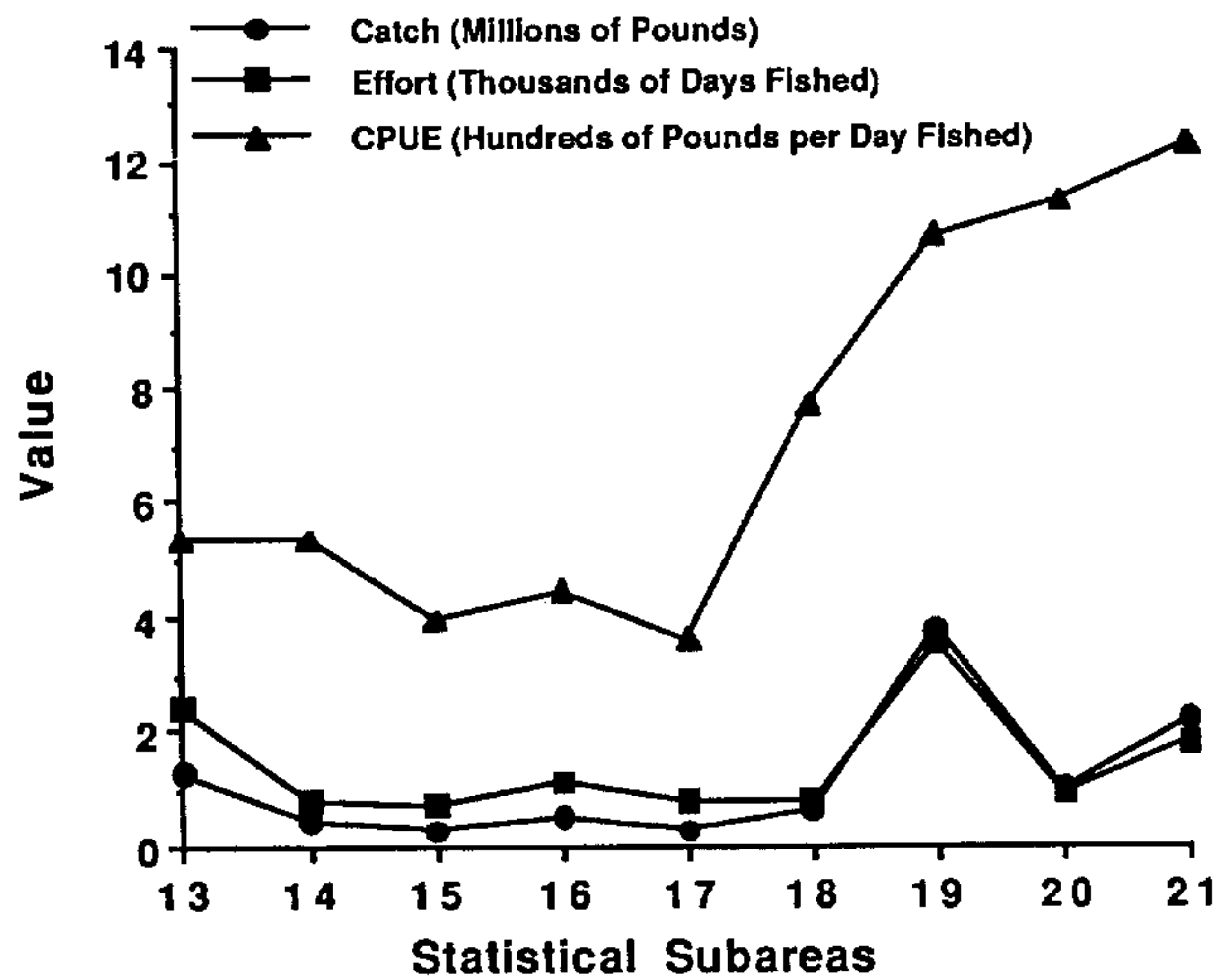
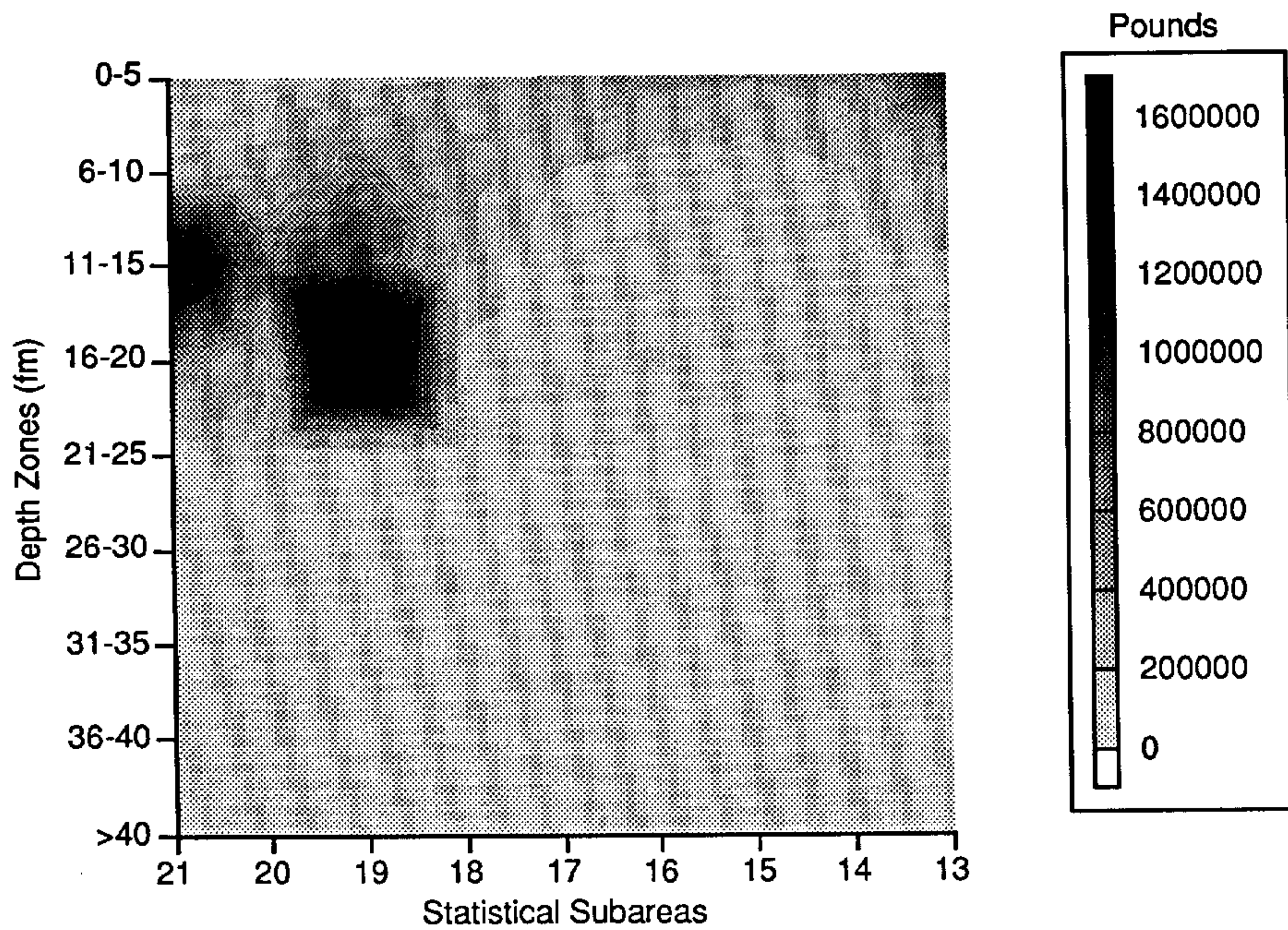


Figure 3. Offshore brown shrimp catch, effort and CPUE during July 1994.

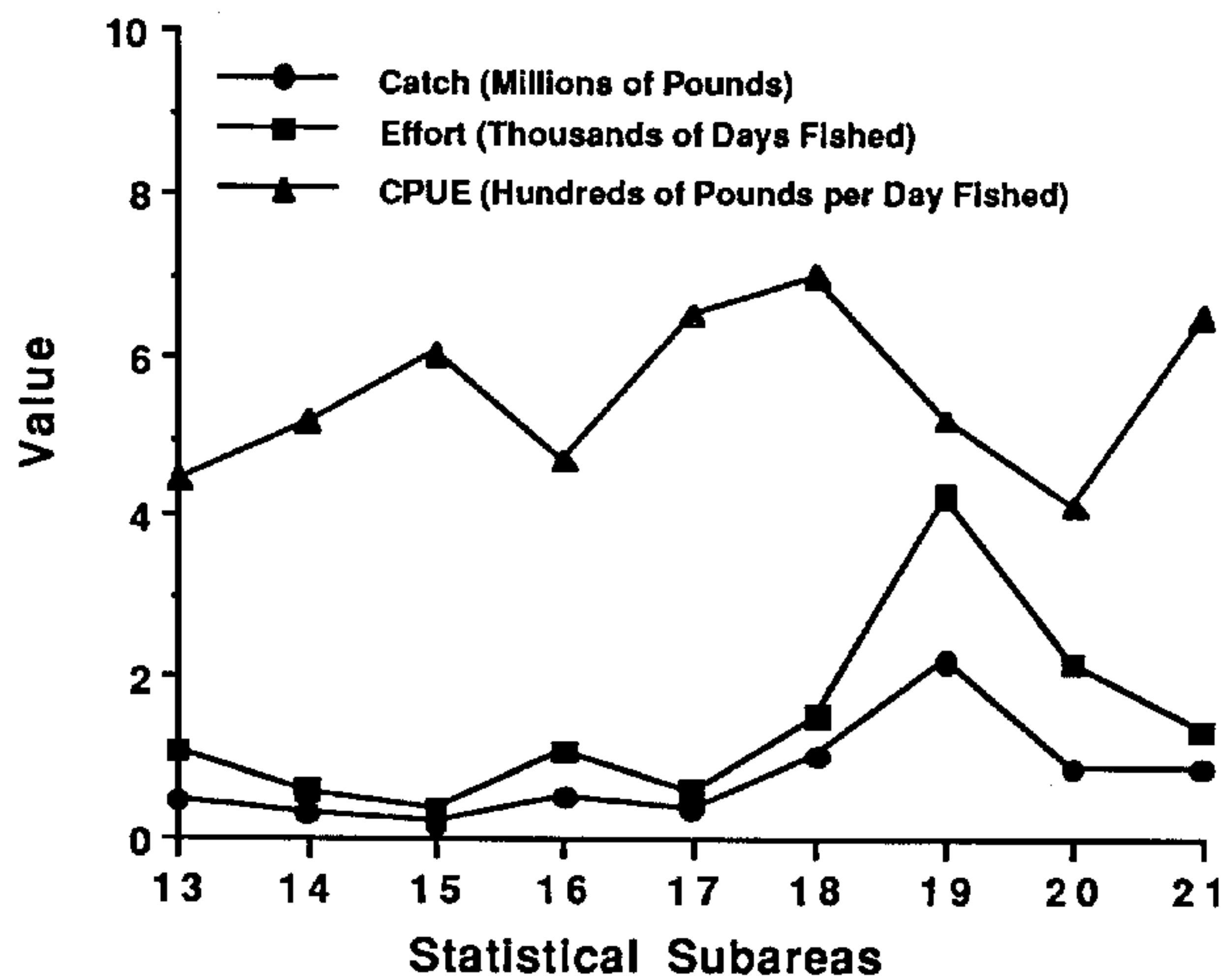
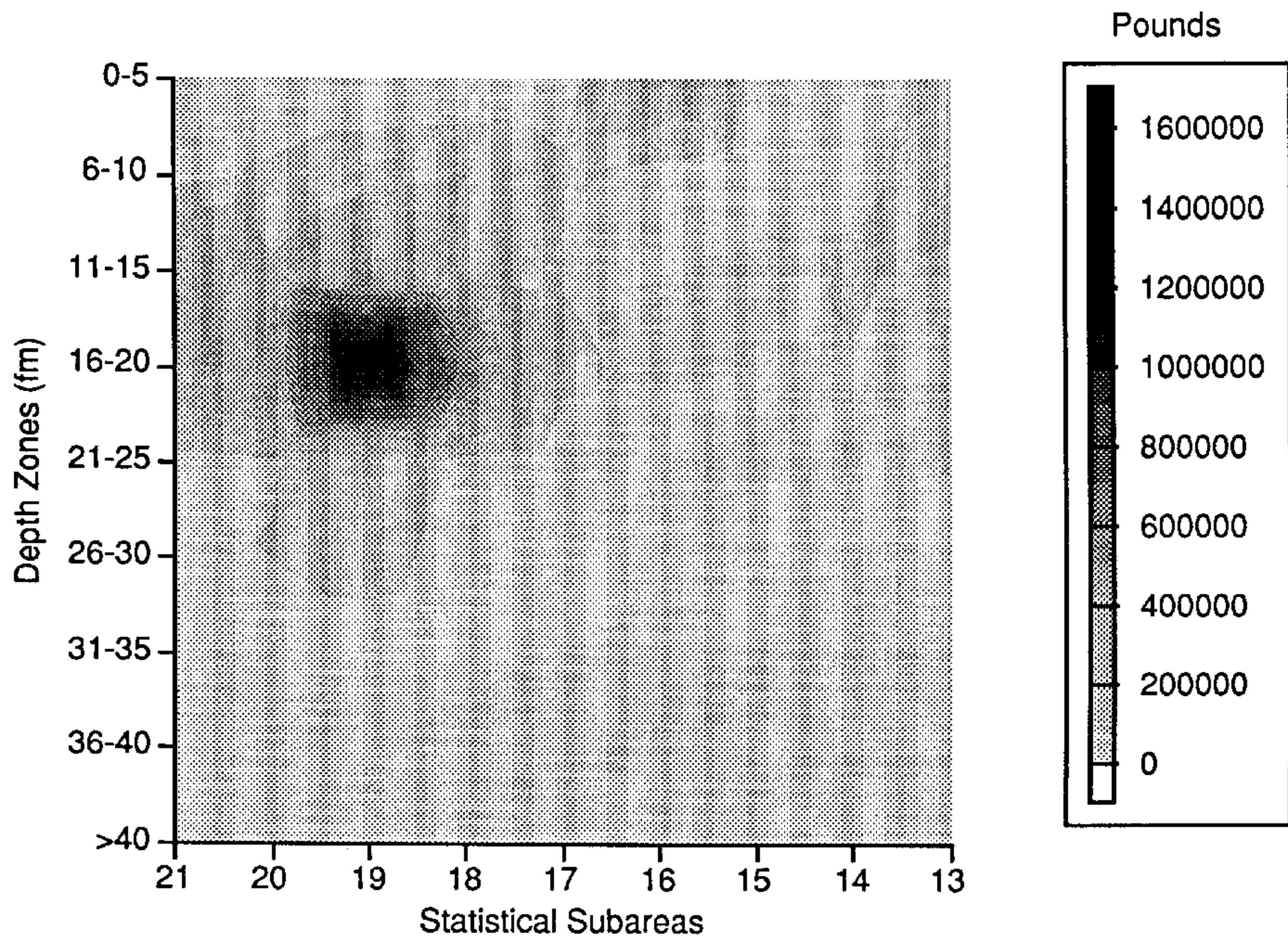


Figure 4. Offshore brown shrimp catch, effort and CPUE during August 1994.

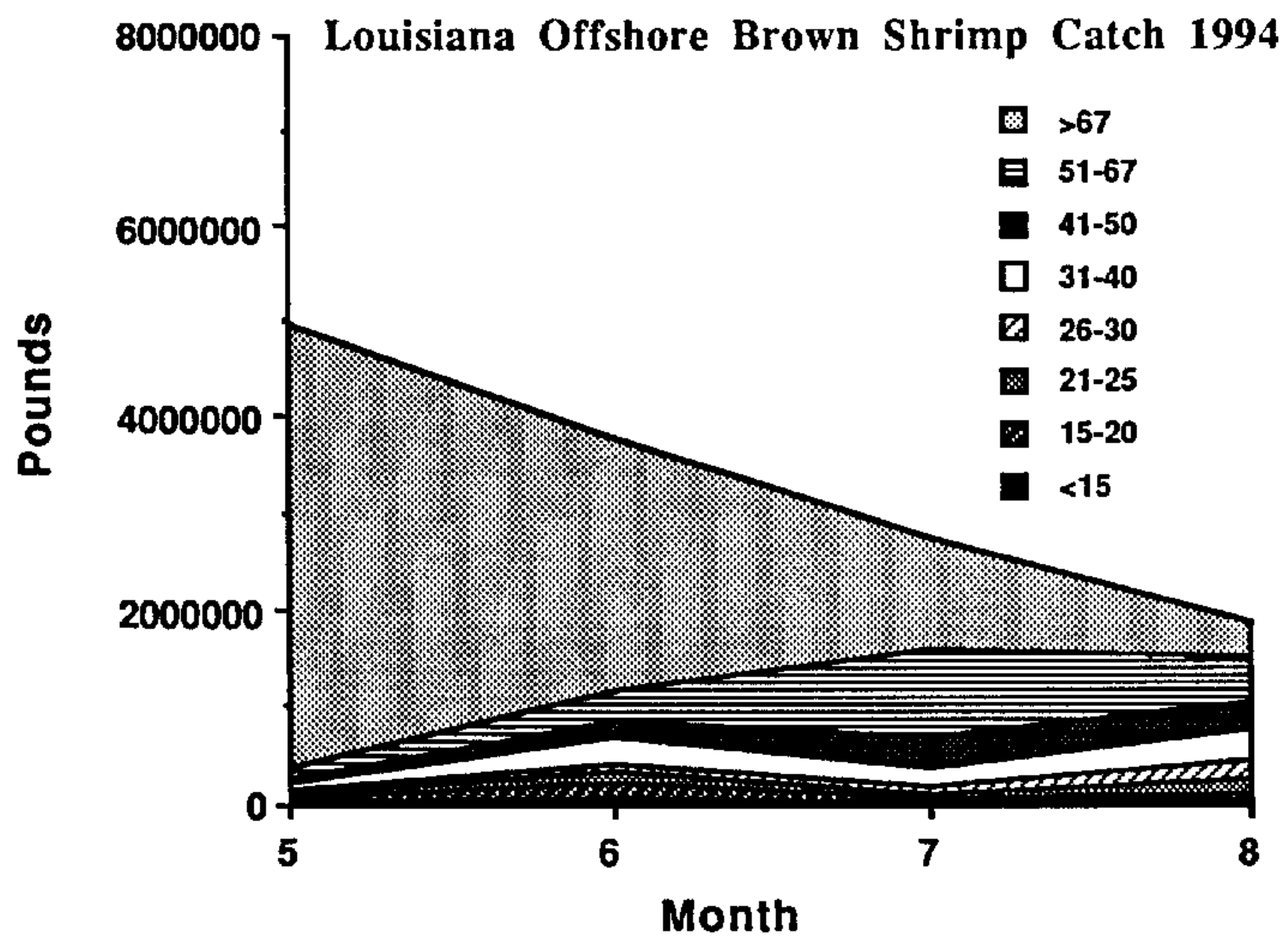


Figure 5. Size composition of brown shrimp taken from offshore Louisiana.

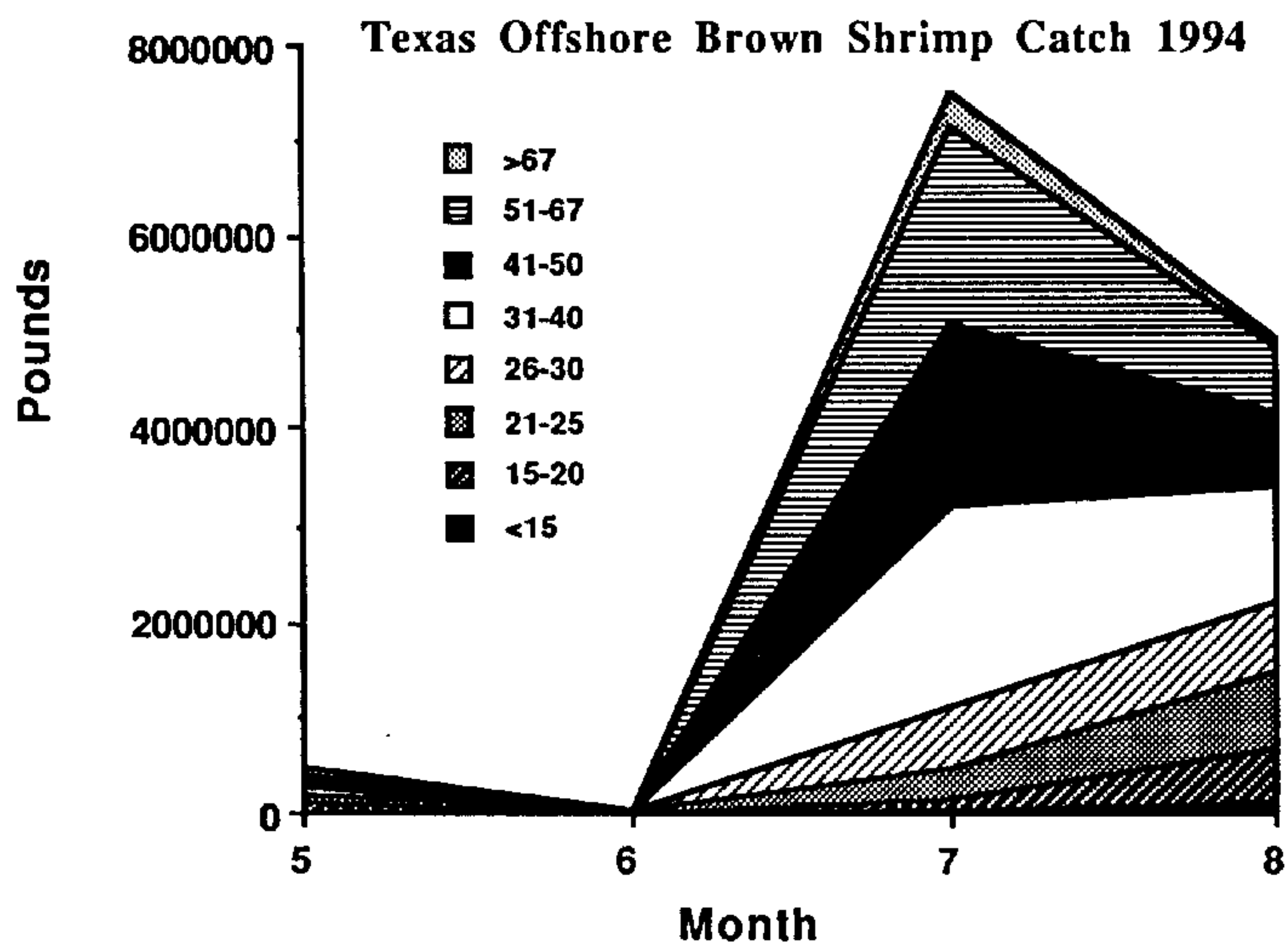


Figure 6. Size composition of brown shrimp taken from offshore Texas.

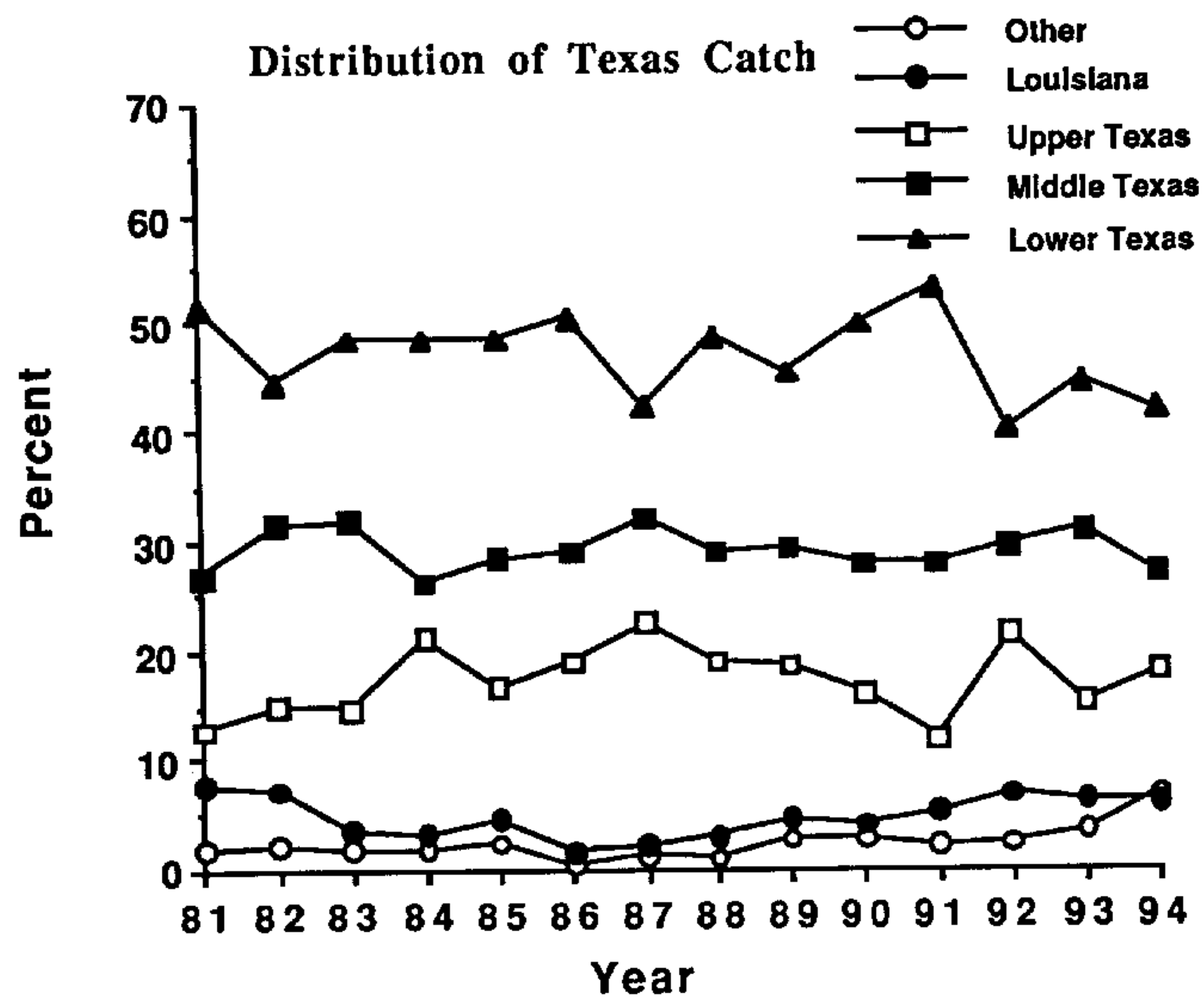


Figure 7. Distribution of May through August total shrimp catch from Texas offshore waters, 1981 - 1994.

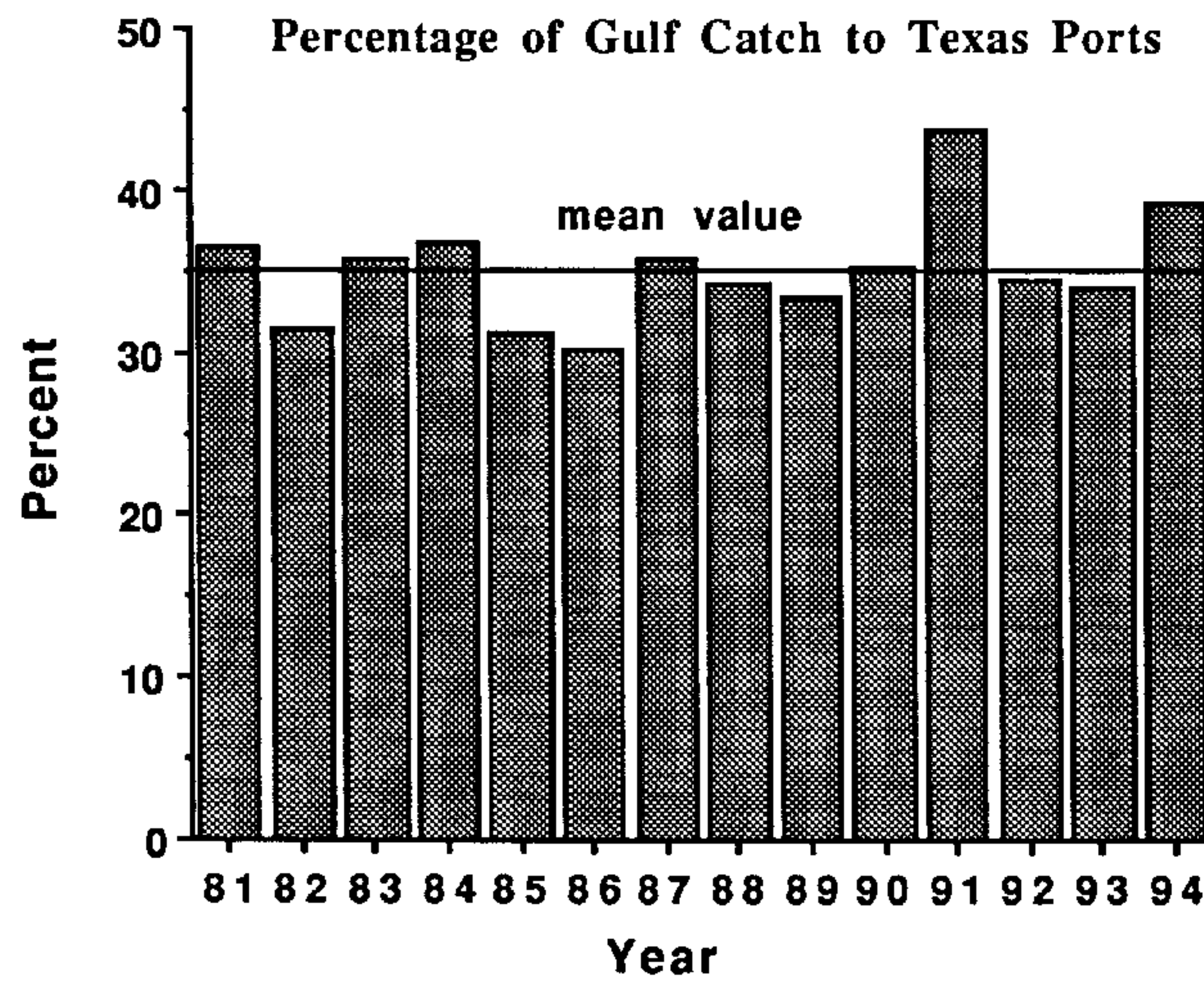


Figure 8. Distribution of May through August Gulf of Mexico shrimp production to all Texas ports, 1981 - 1994.

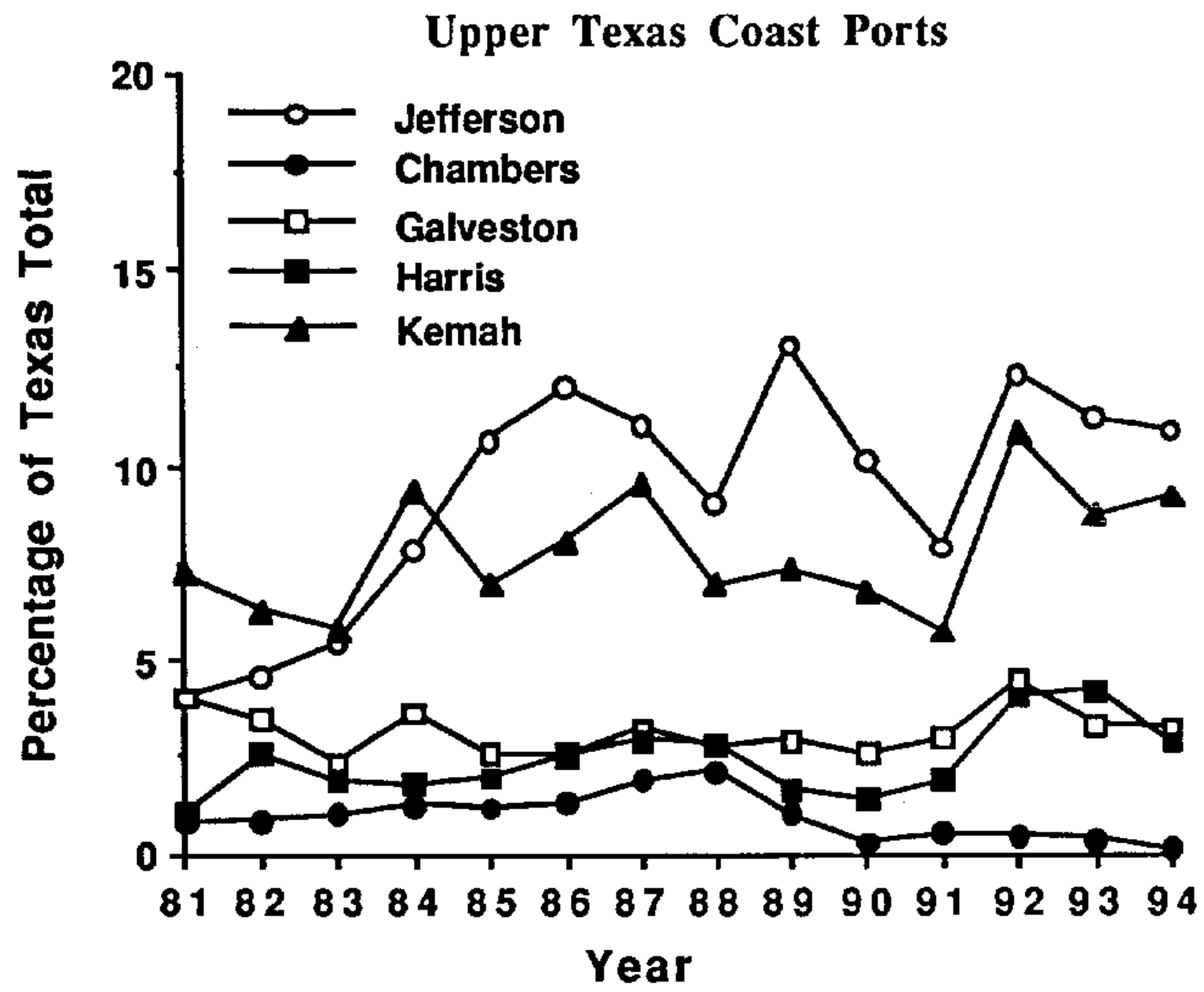


Figure 9. Distribution of May through August Texas landings by upper coast ports, 1981 - 1994.

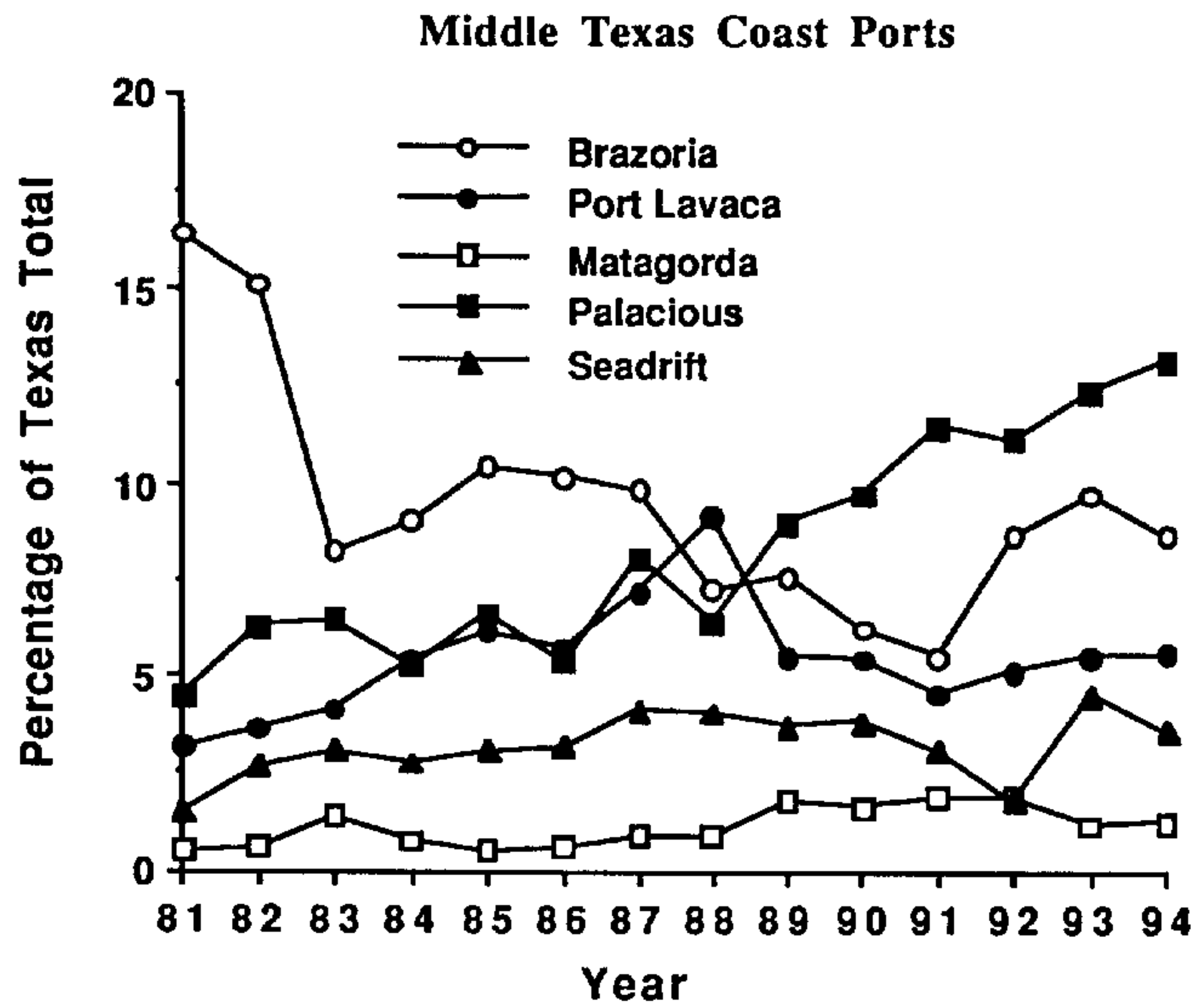


Figure 10. Distribution of May through August Texas landings by middle coast ports, 1981 - 1994.

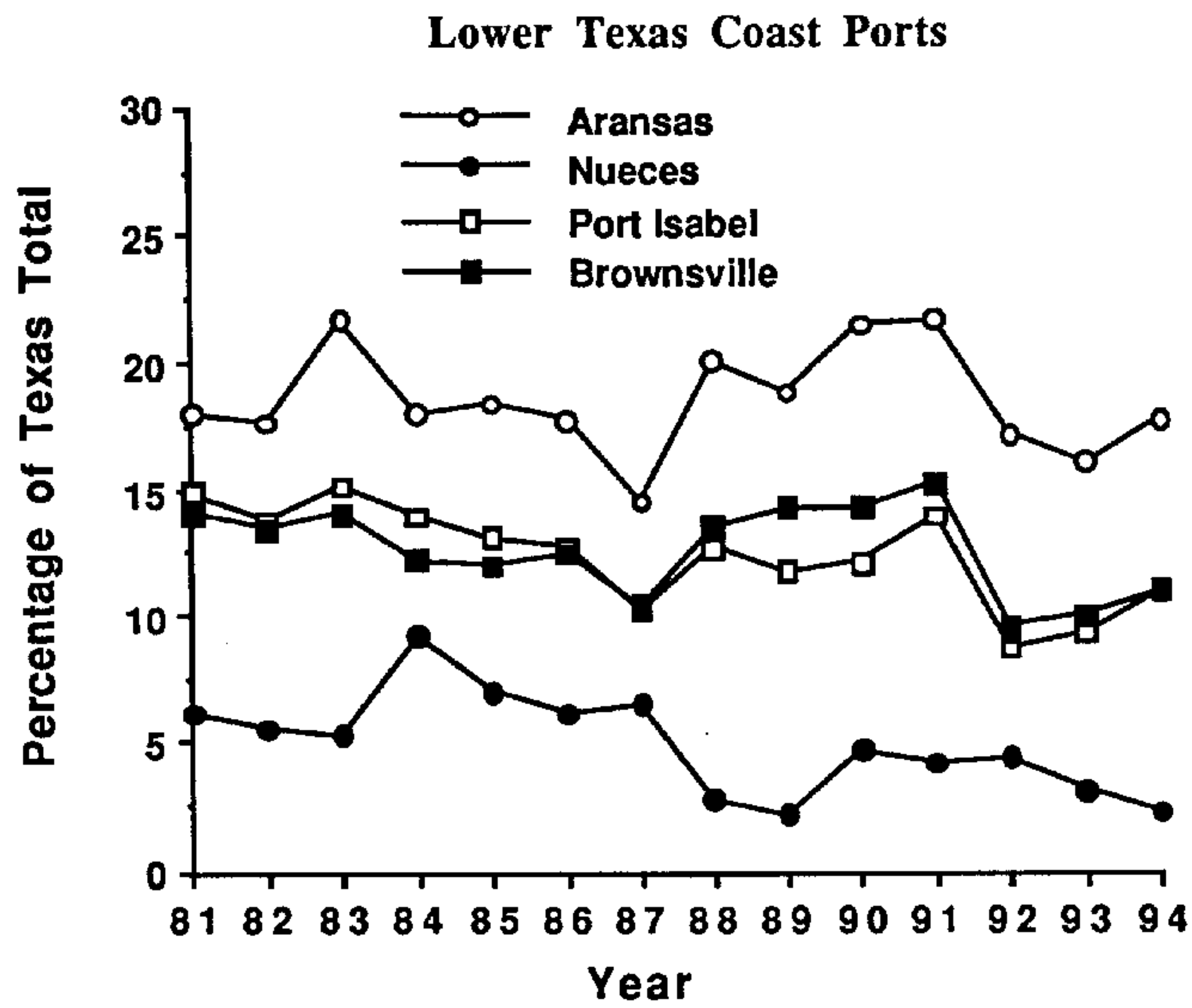


Figure 11. Distribution of May through August Texas landings by lower coast ports, 1981 - 1994.

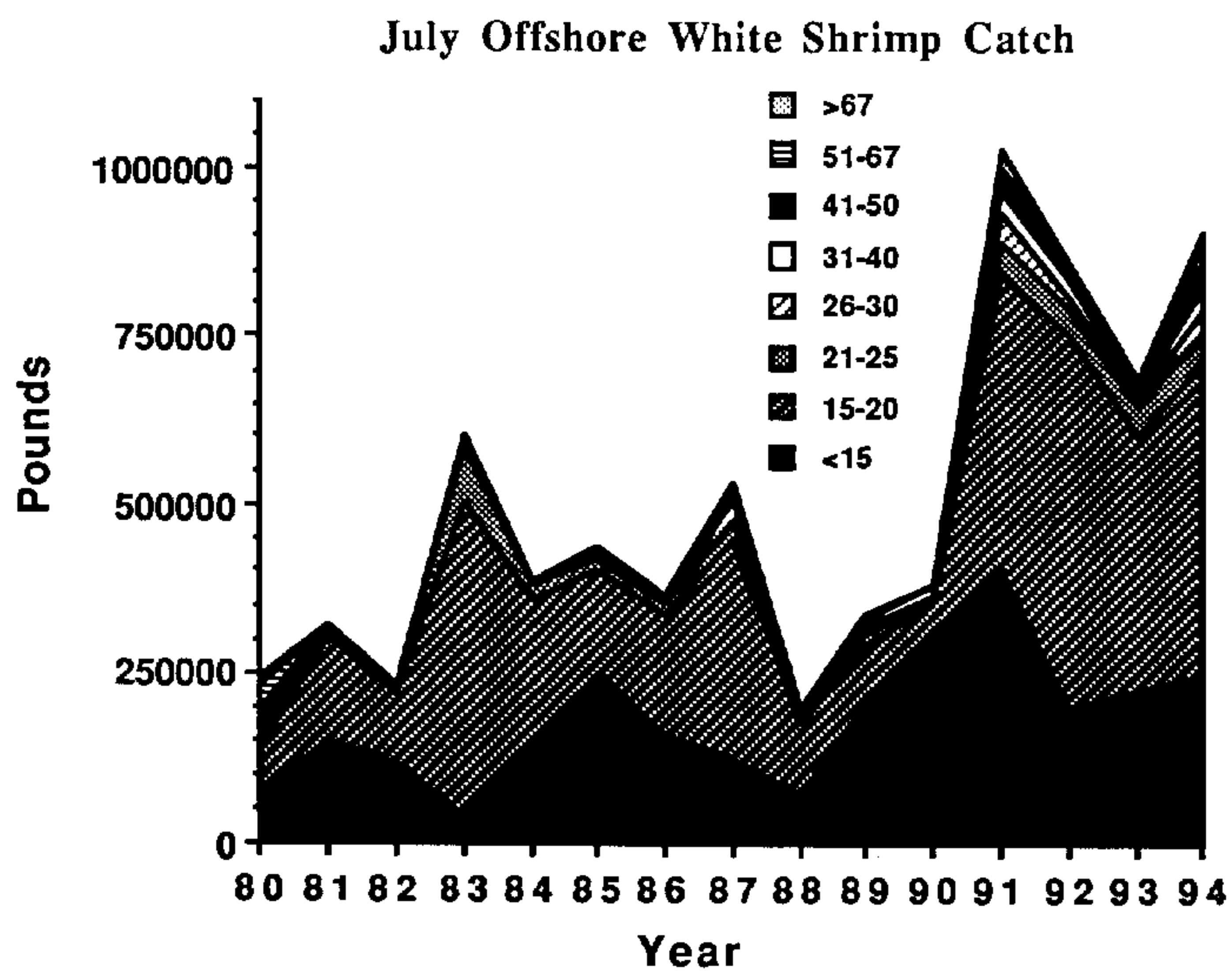


Figure 12. White shrimp size distribution off the Texas coast from 1980 - 1994 during July.

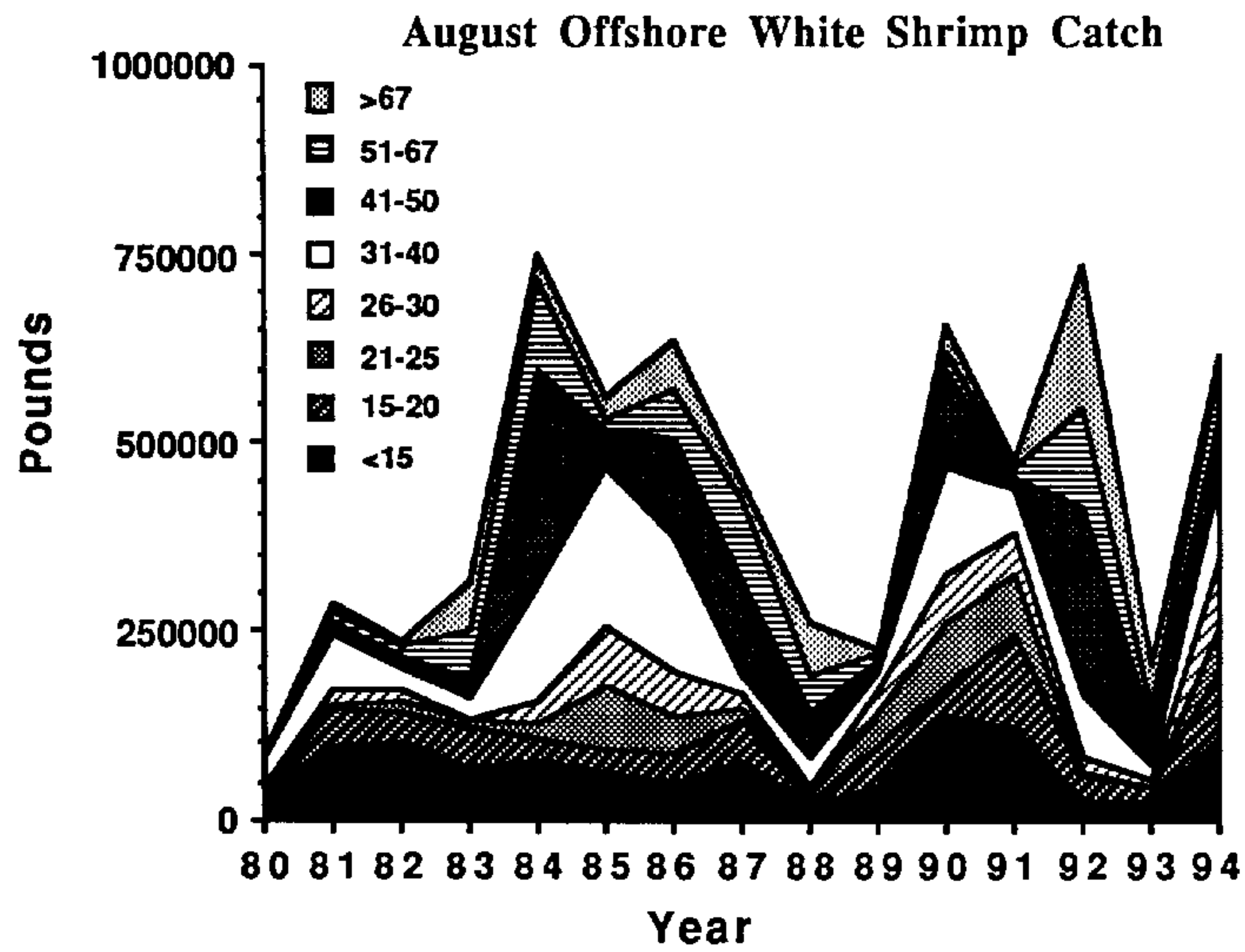


Figure 13. White shrimp size distribution off the Texas coast from 1980 - 1994 during August.